

Solar wind charge exchange and the ROSAT sky-maps

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Outline

- The steady state component of the soft X-ray contamination in the ROSAT sky-maps could not be removed.
- We have calculated this steady state component and will discuss its contribution to the $\frac{1}{4}$ and $\frac{3}{4}$ keV all-sky survey maps.
- Observing solar wind charge exchange X-ray emission with soft X-ray detectors from a point outside Earth's magnetosheath will give a more accurate estimate of the heliospheric contamination.

Solar wind Charge Exchange

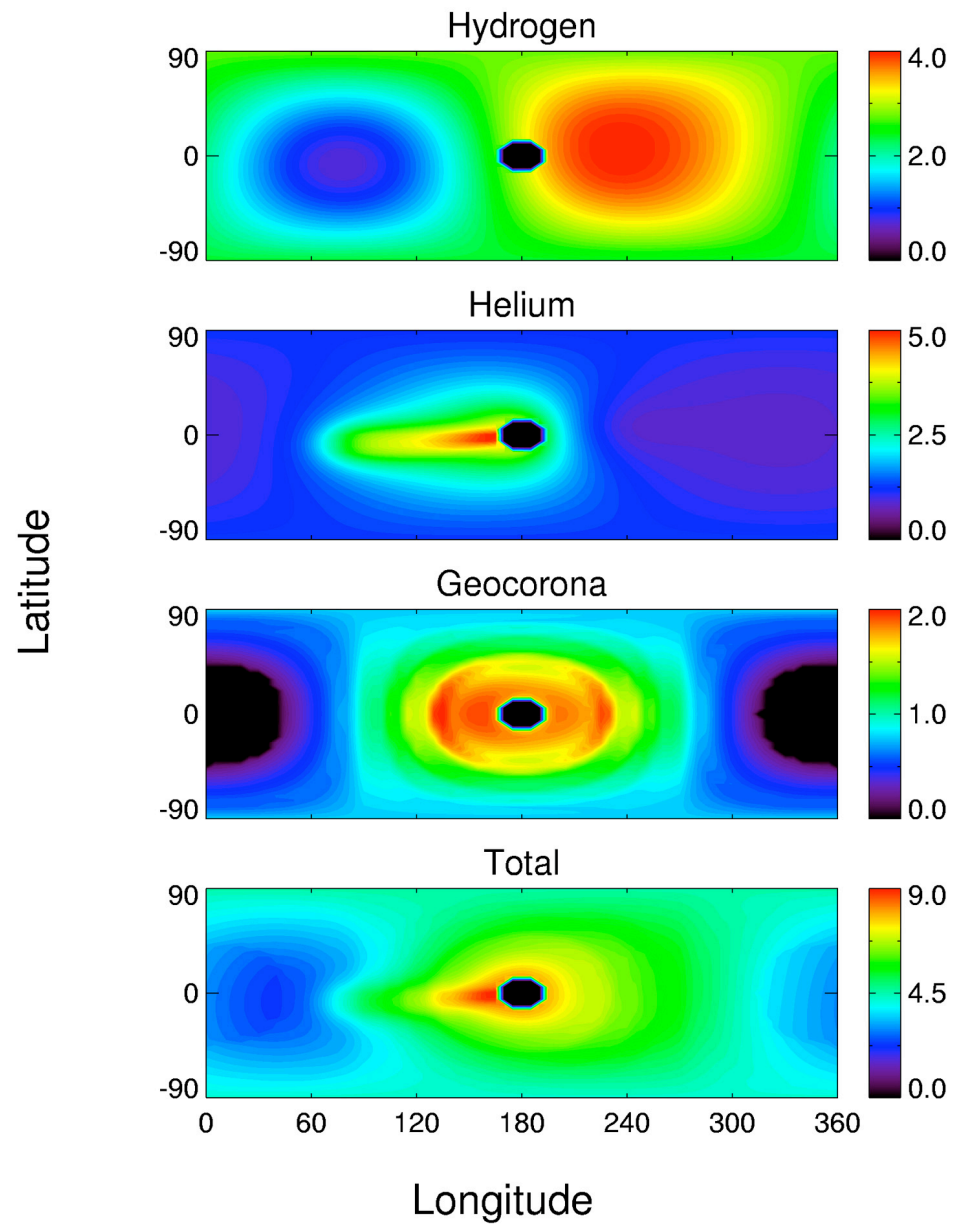
- The production rate P is

$$P = \alpha n_{\text{sw}} u_{\text{sw}} n_n$$

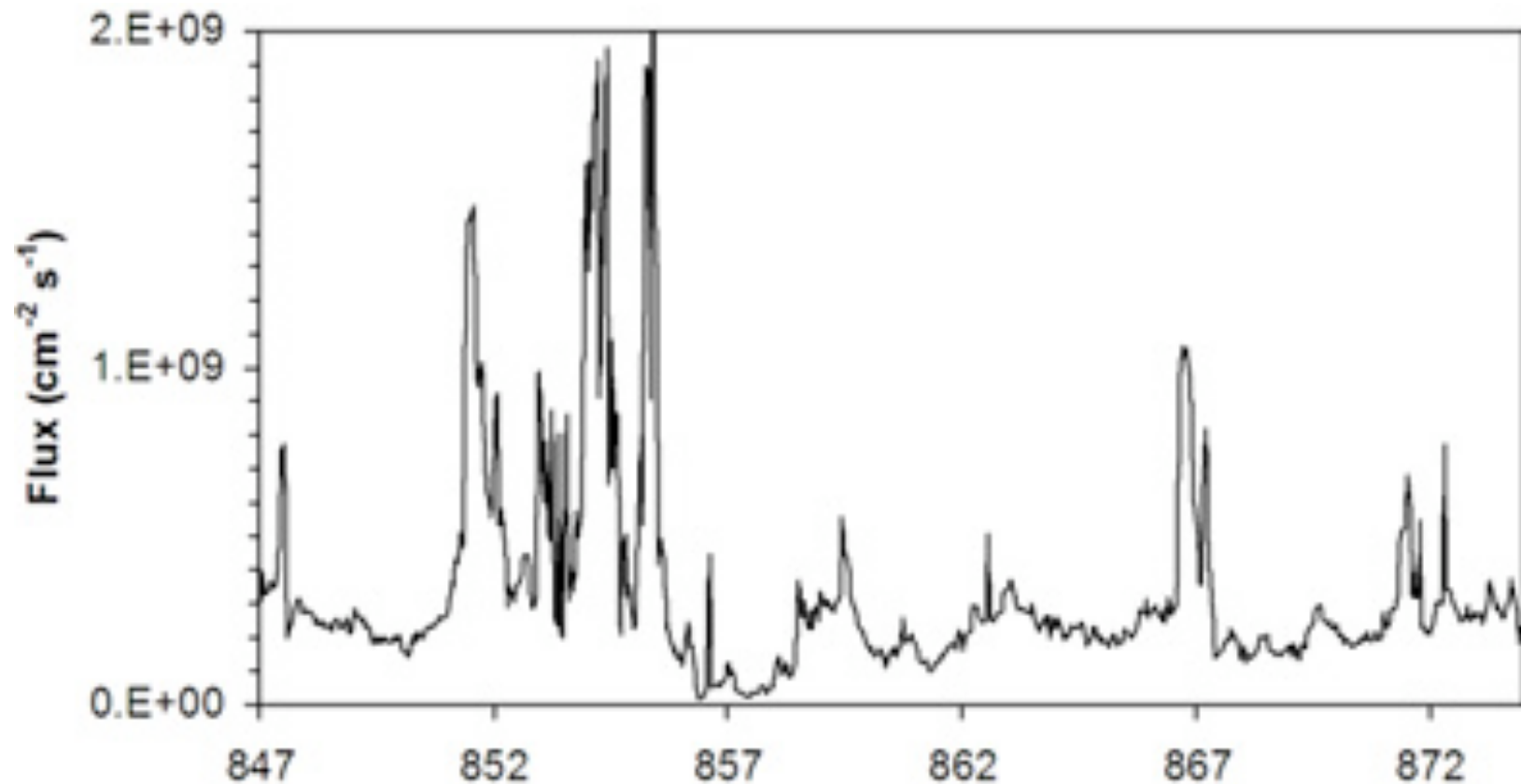
- The total intensity is

$$\int P ds$$

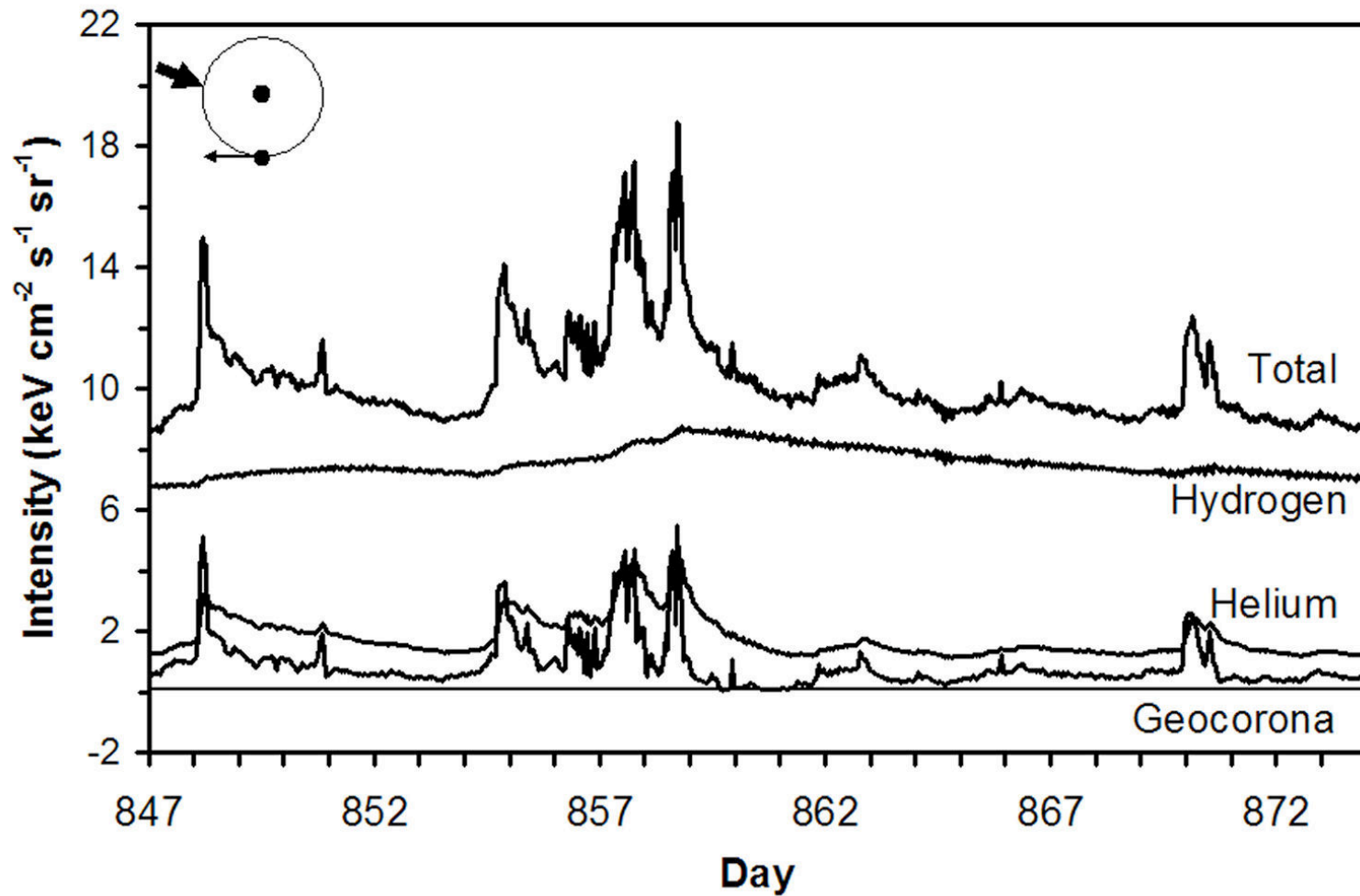
Neutral densities



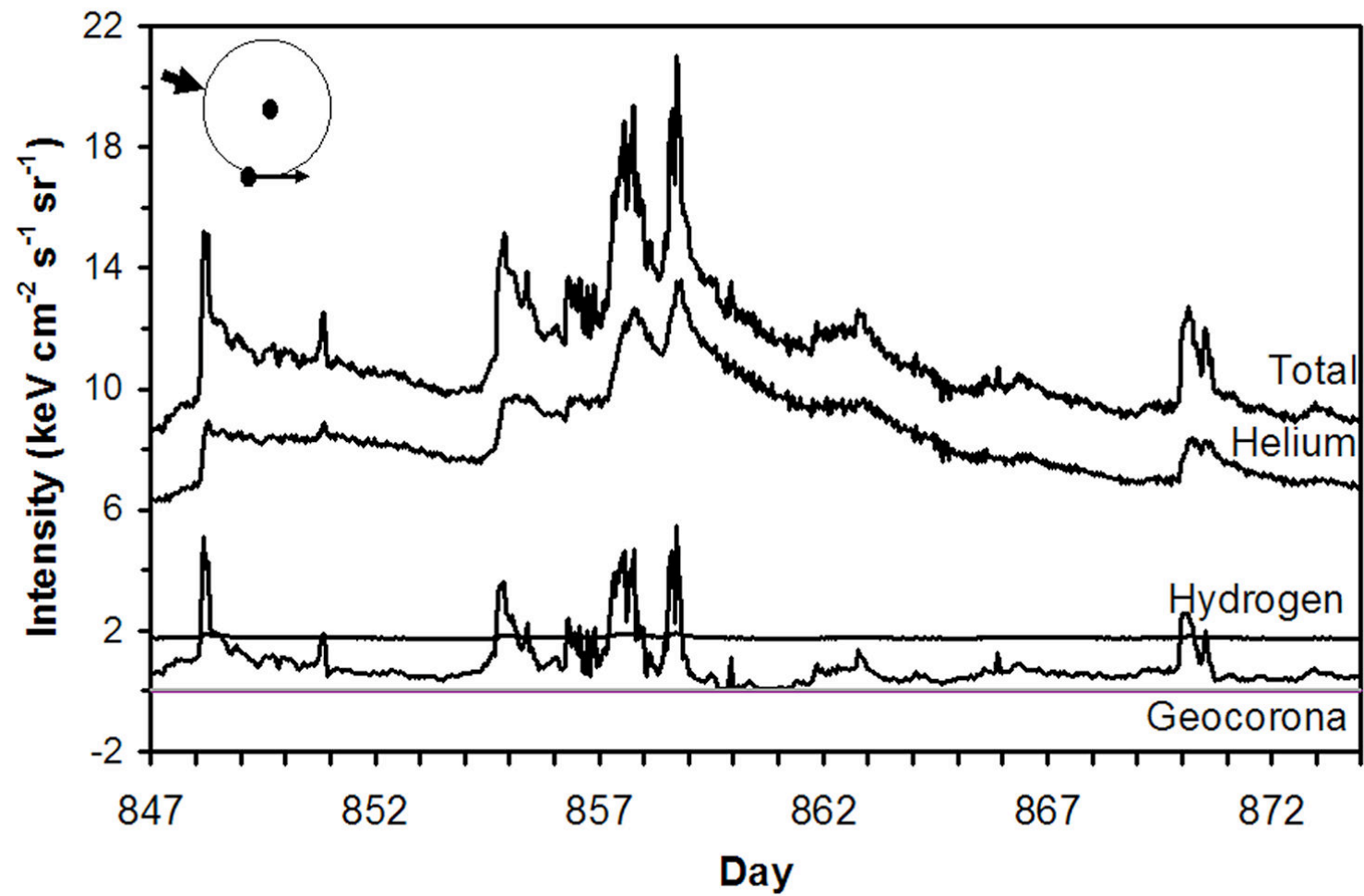
Test Case - effect of a distinct solar wind flux



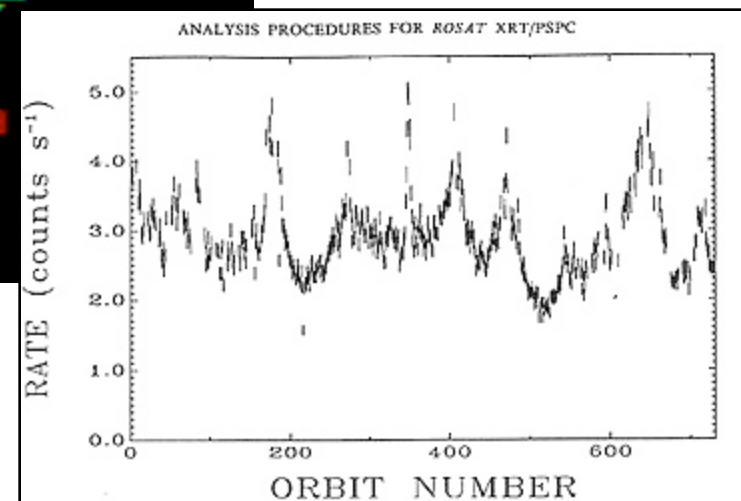
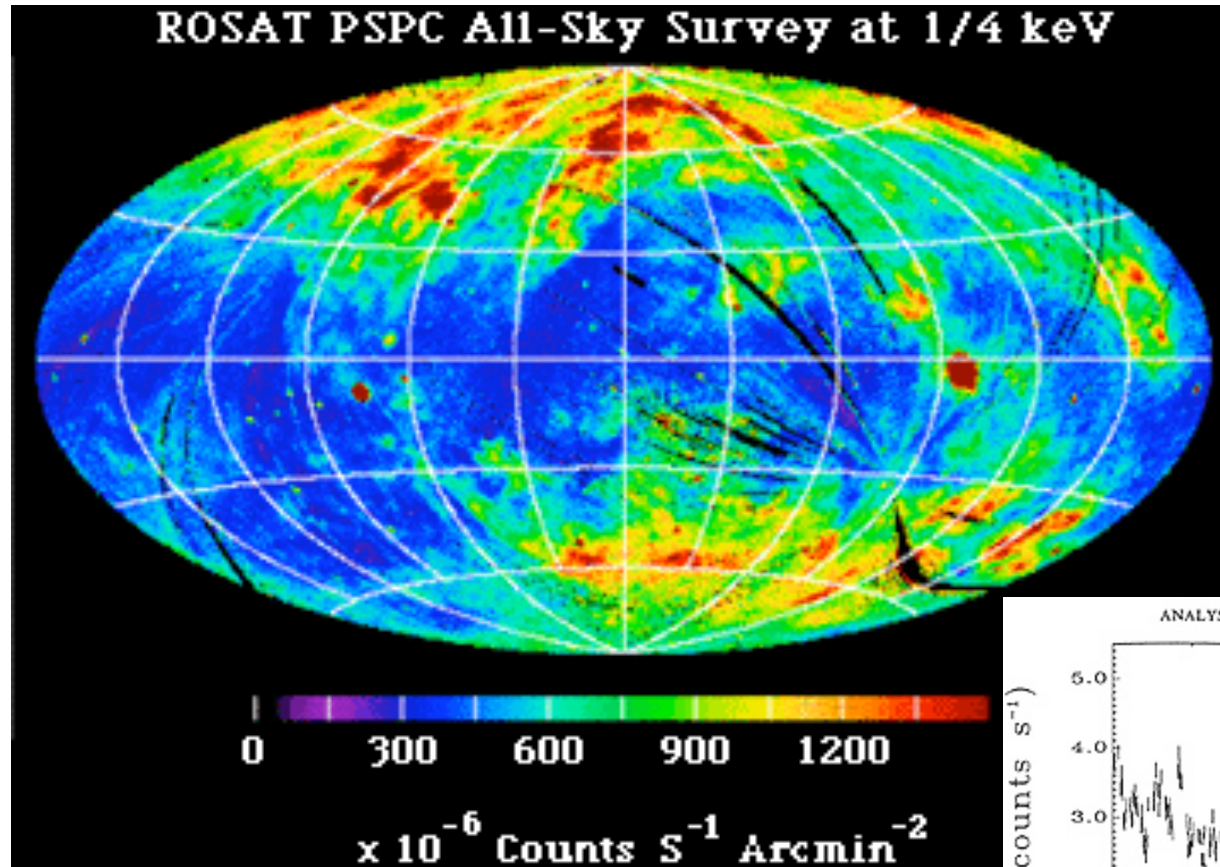
Looking 'upwind'



Looking 'downwind'



Rosat All-Sky Survey

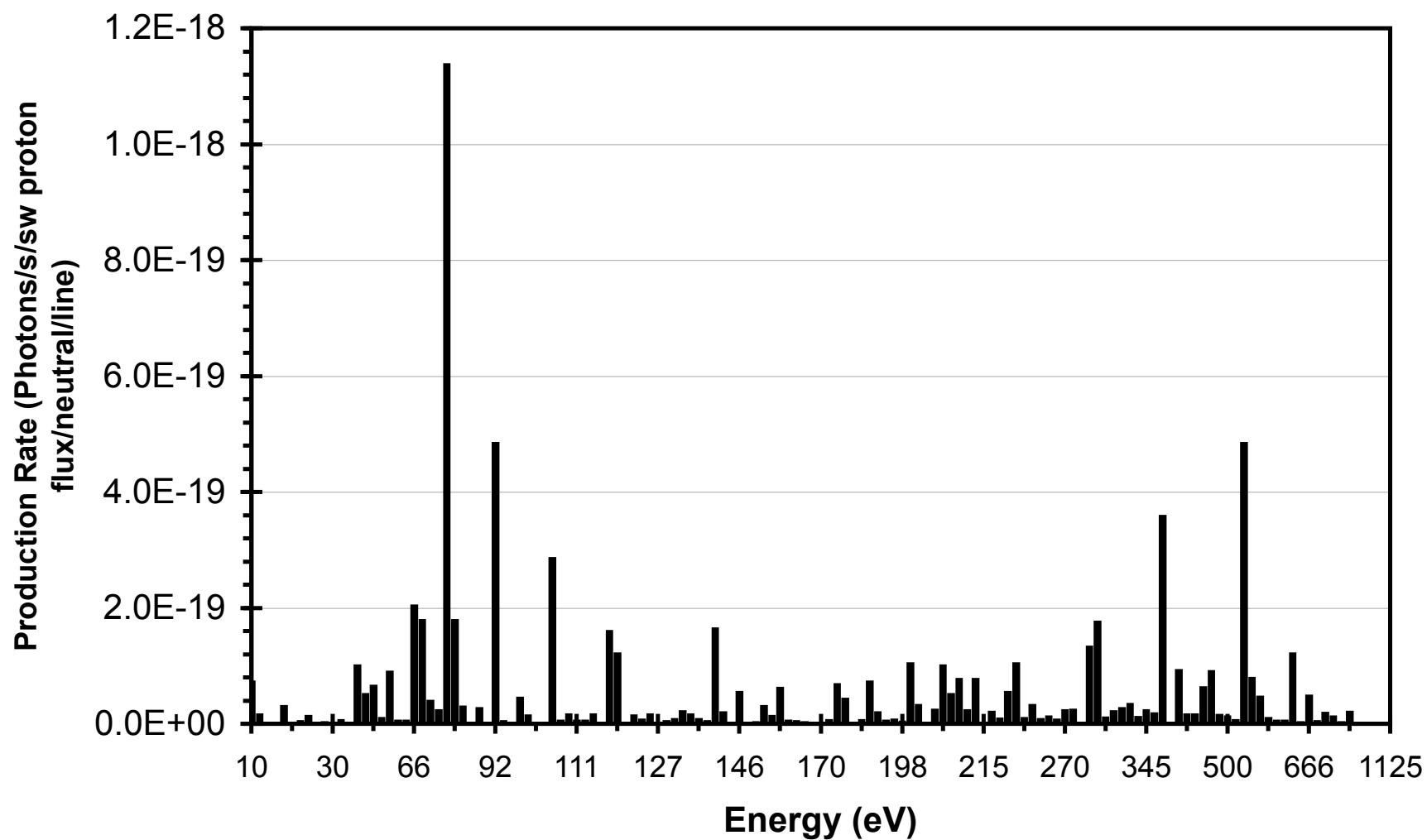


Objective of our study

1. Determine the steady state component of the charge exchange emission for the 1/4 and 3/4 keV bands
2. Subtract that component from the sky-maps

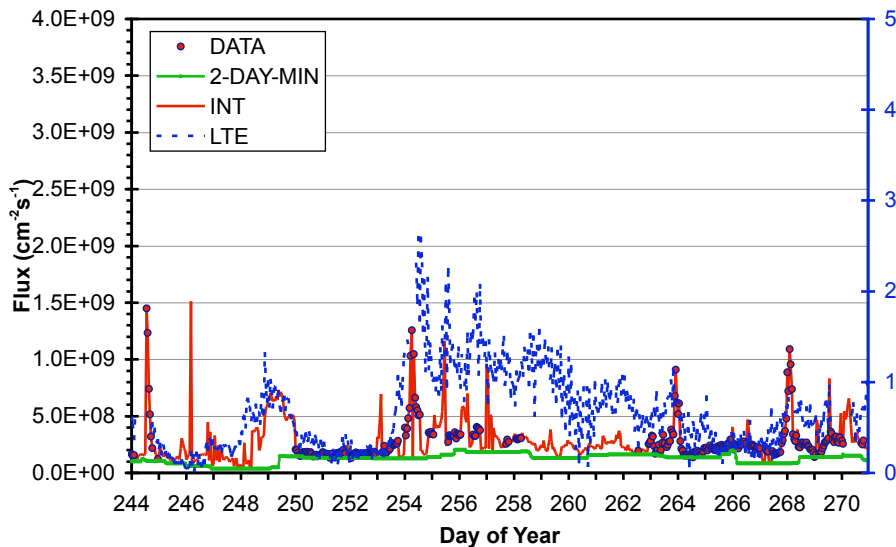
Solar Wind Composition

Schwadron & Cravens Slow Solar Wind

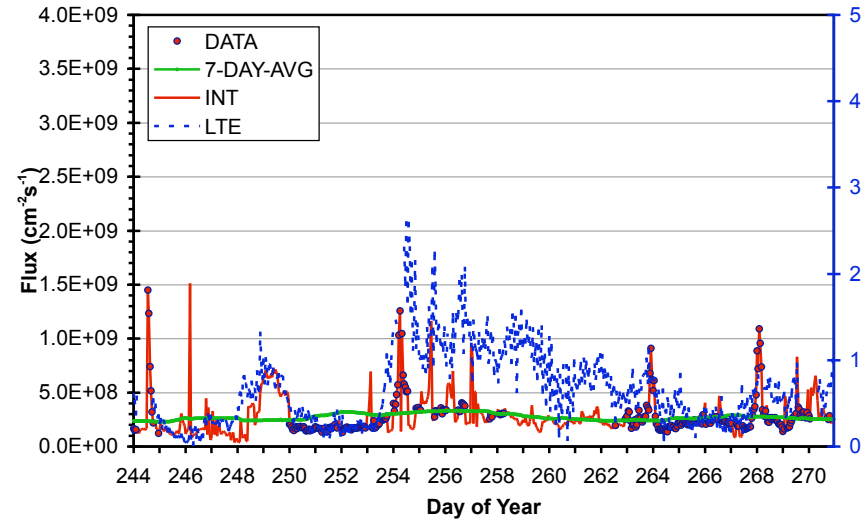


Solar Wind Flux

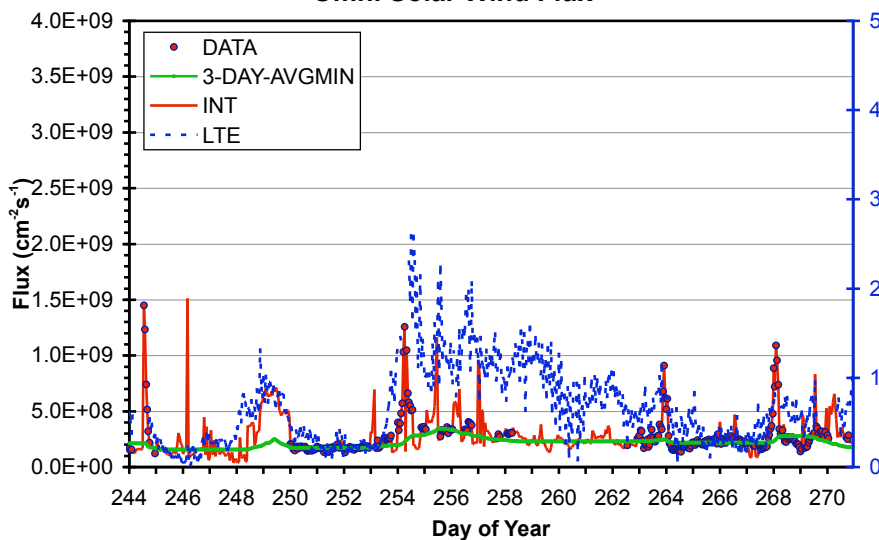
September 1 - September 27, 1990
Omni Solar Wind Flux



September 1 - September 27, 1990
Omni Solar Wind Flux

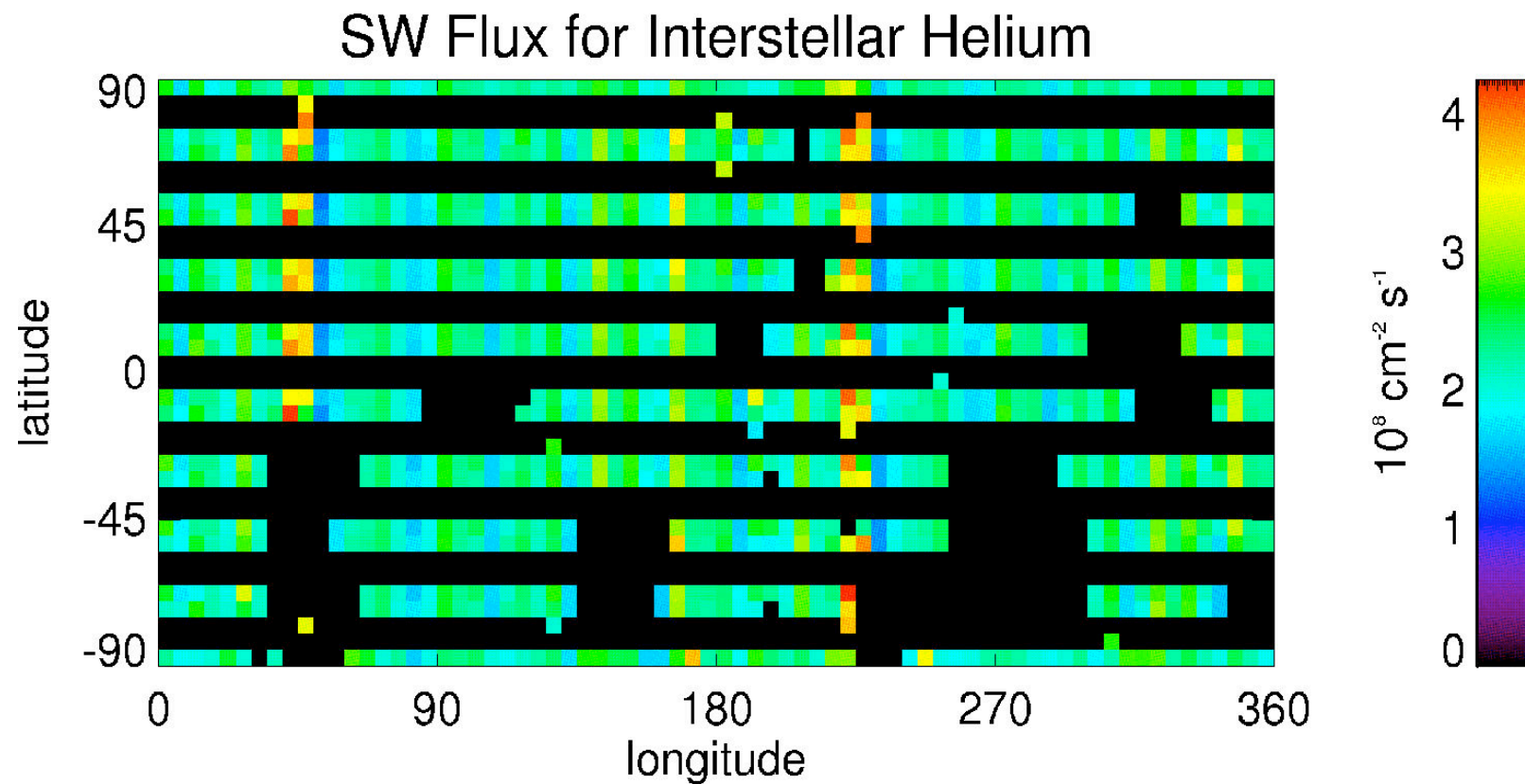


September 1 - September 27, 1990
Omni Solar Wind Flux



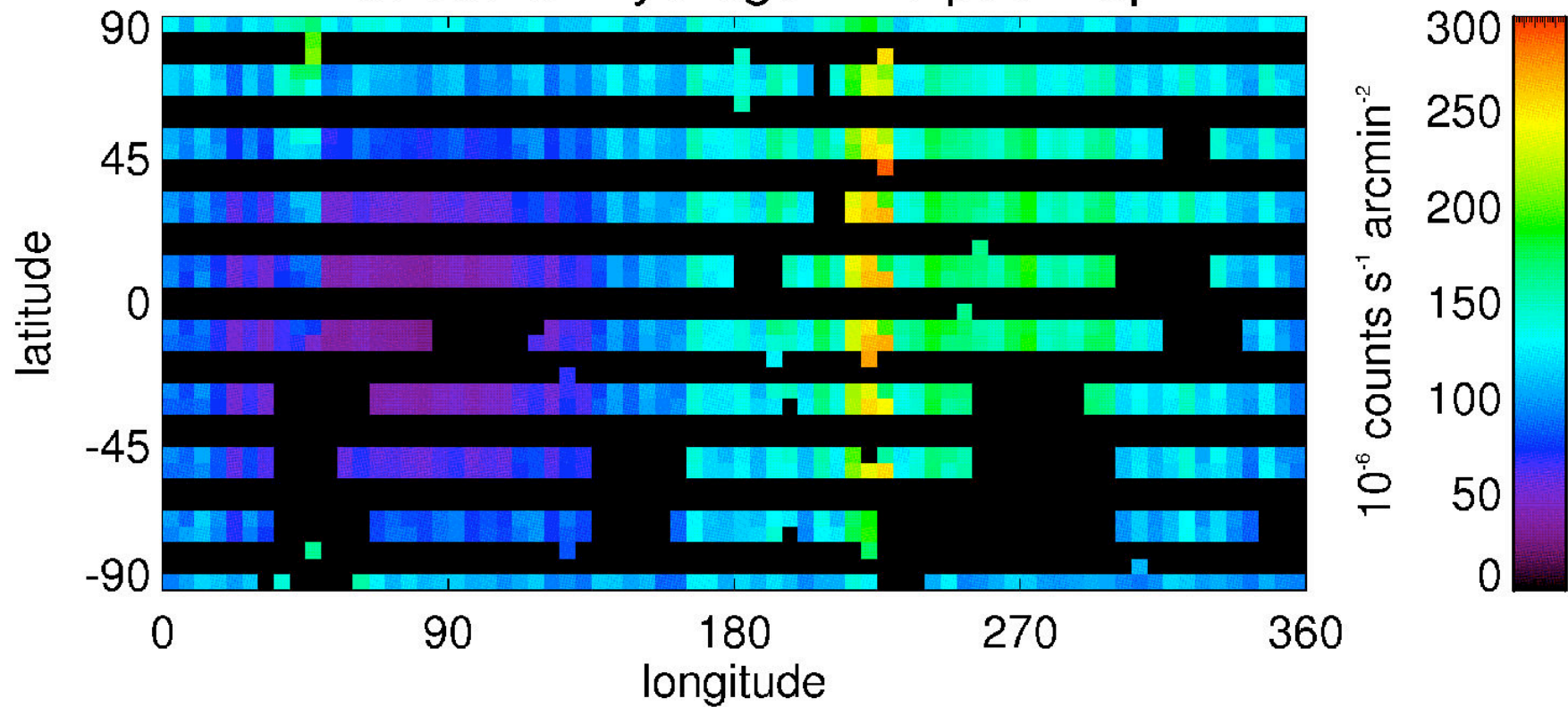
A 2-day running minimum
is used for geocoronal SWCX.
A 7-day running average is
used for SWCX with int. H.
A 3-day running average,
followed by a 3-day running
minimum is used for SWCX with
int. He

Solar wind flux for SWCX with interstellar H



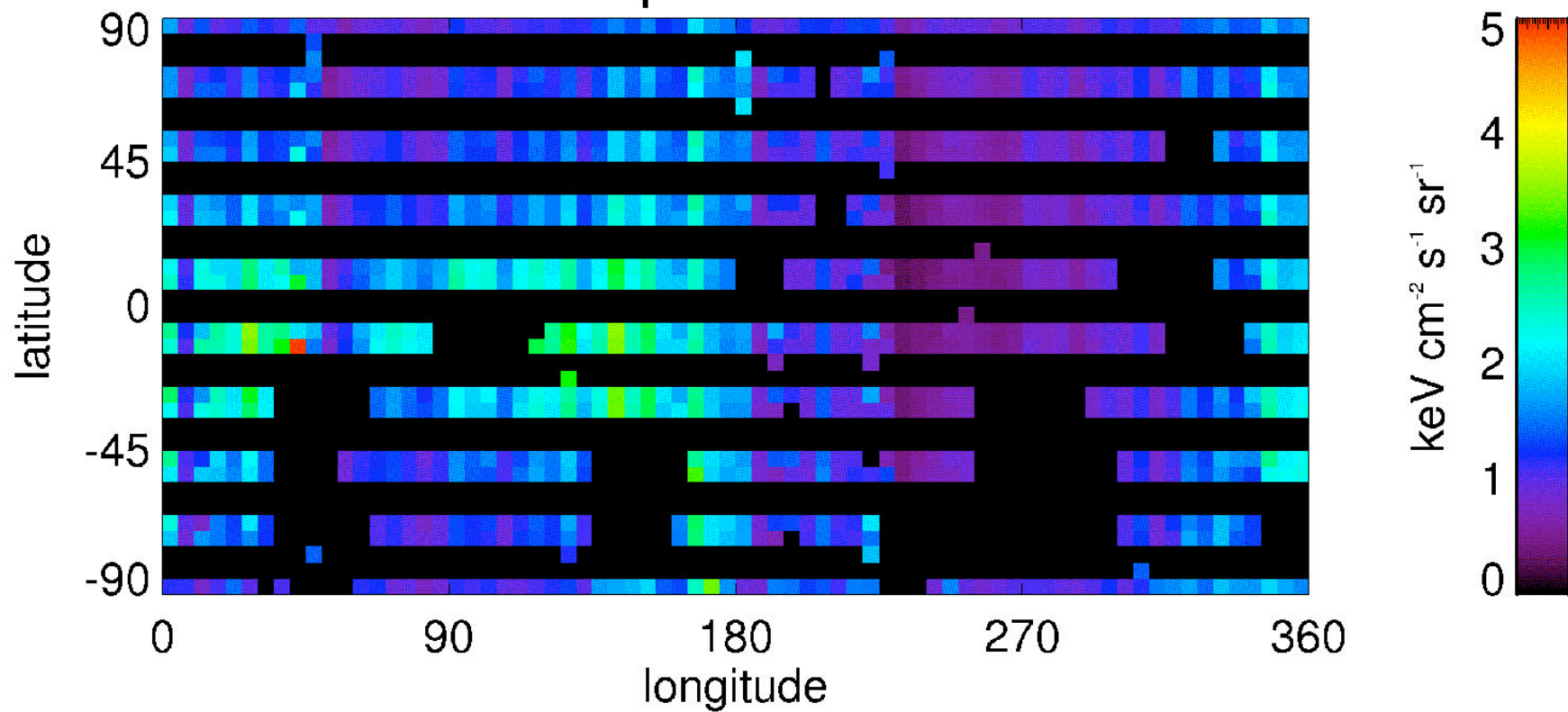
X-ray Intensities

Interstellar Hydrogen Ecliptic Map

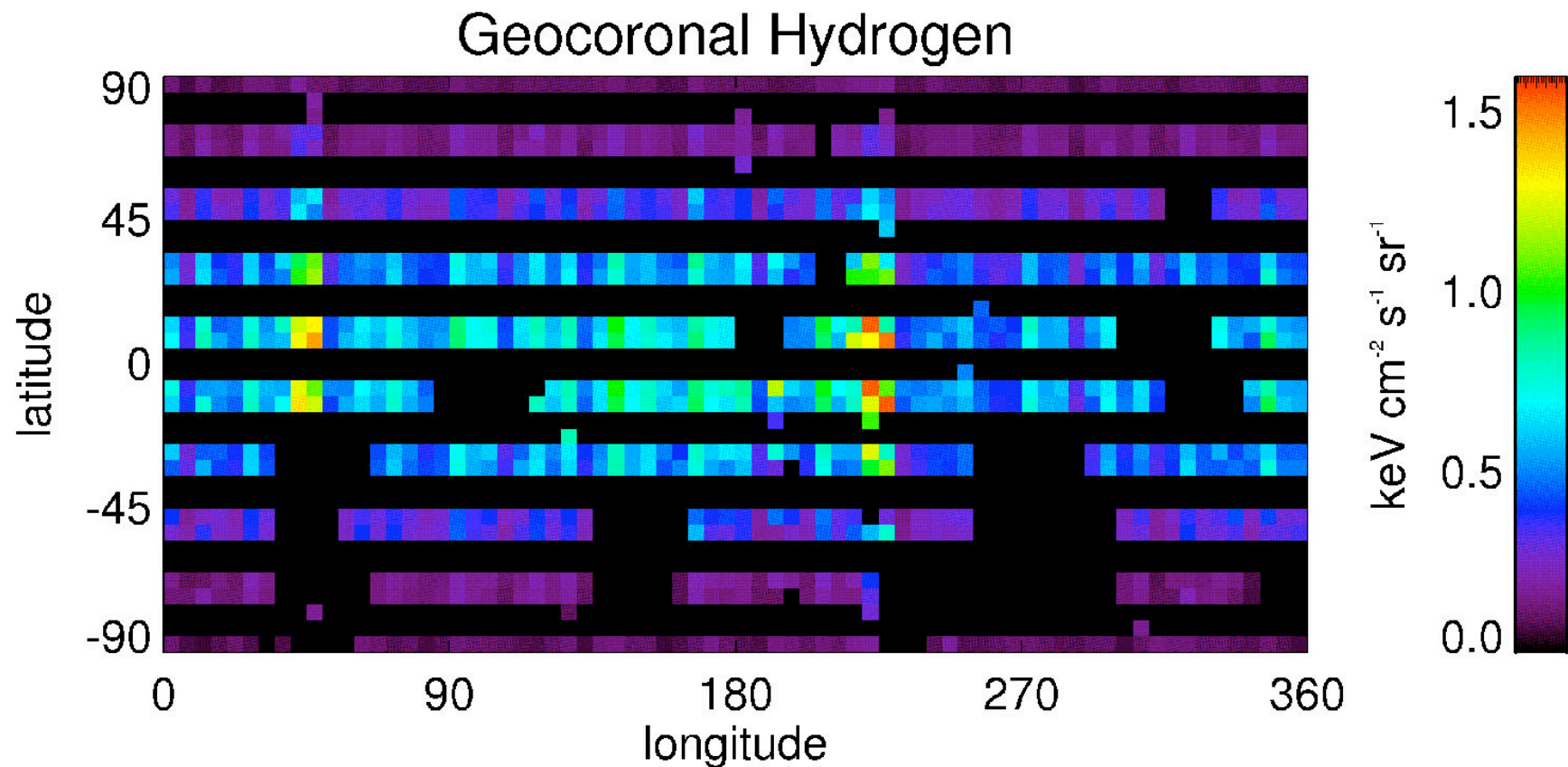


X-Ray intensities

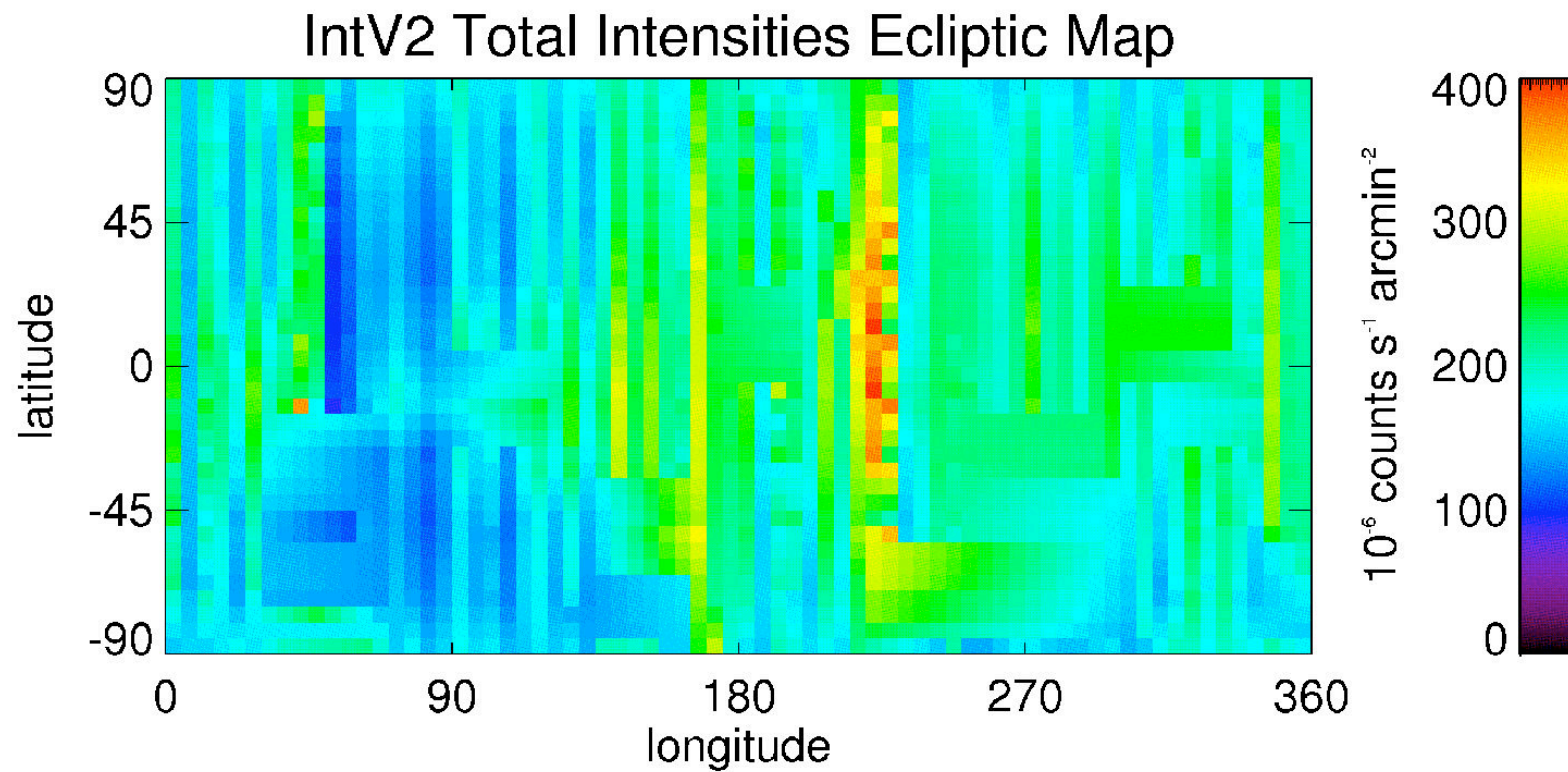
Heliospheric Helium



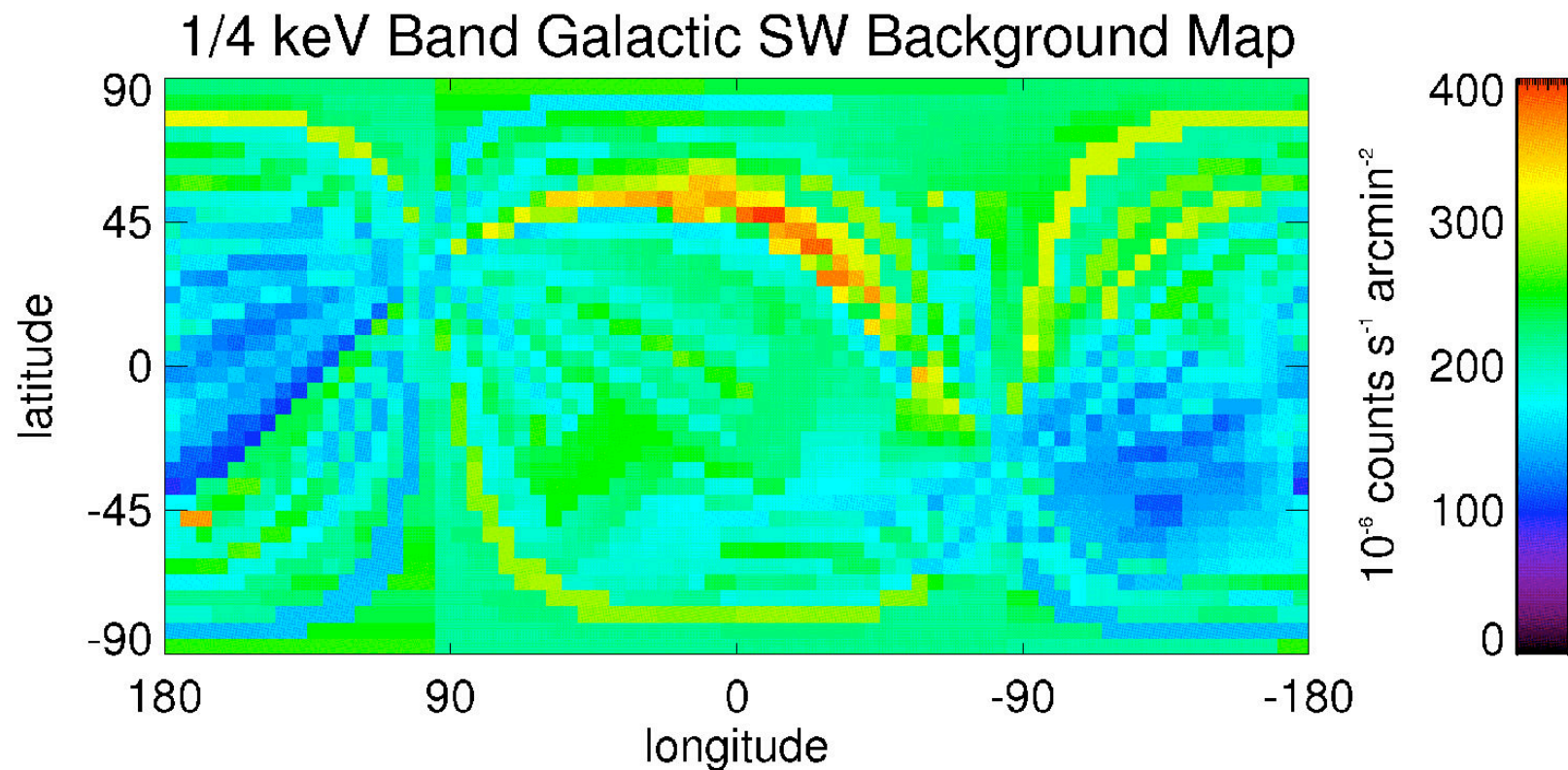
X-Ray Intensities



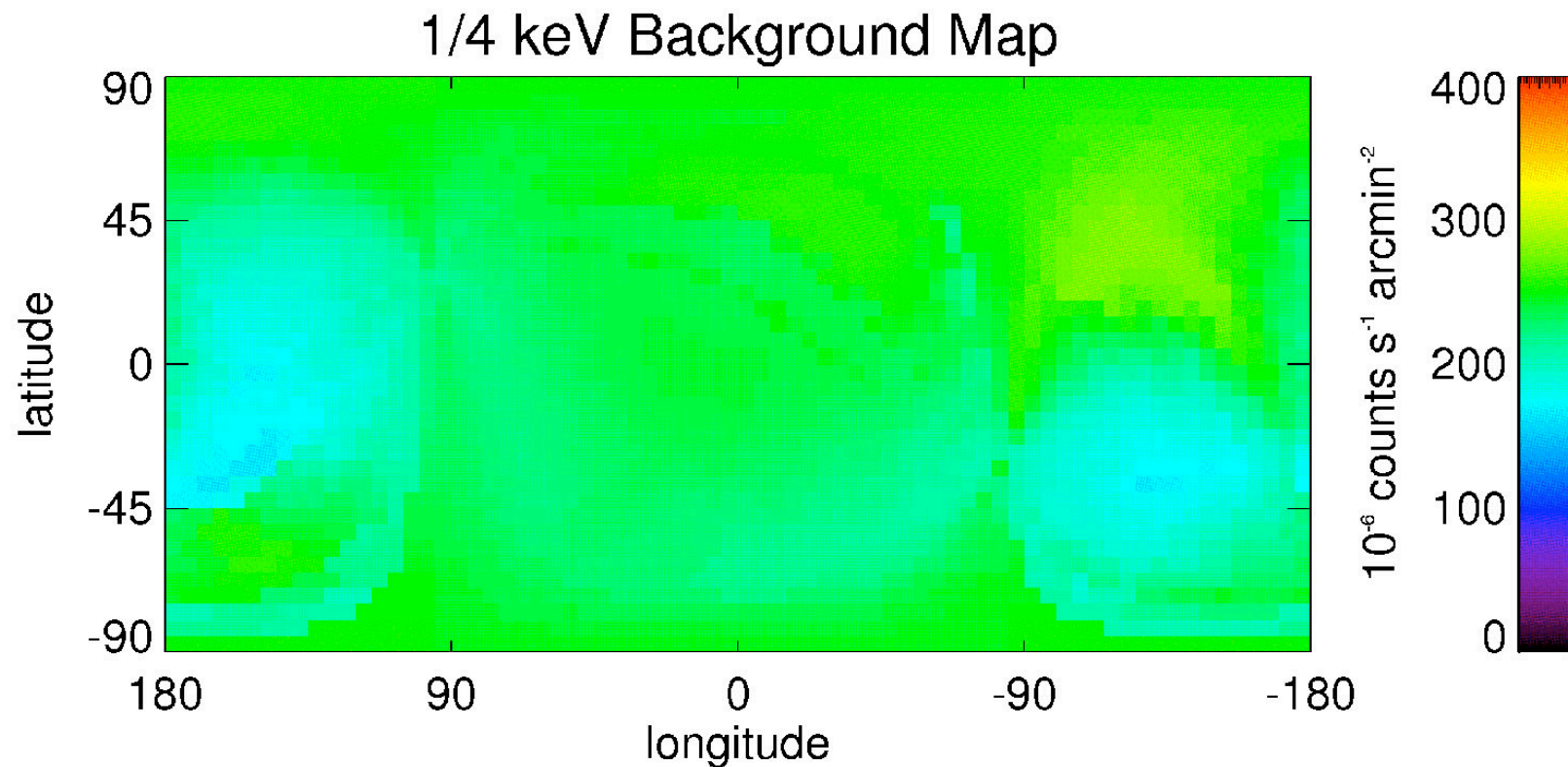
Total X-ray Intensities



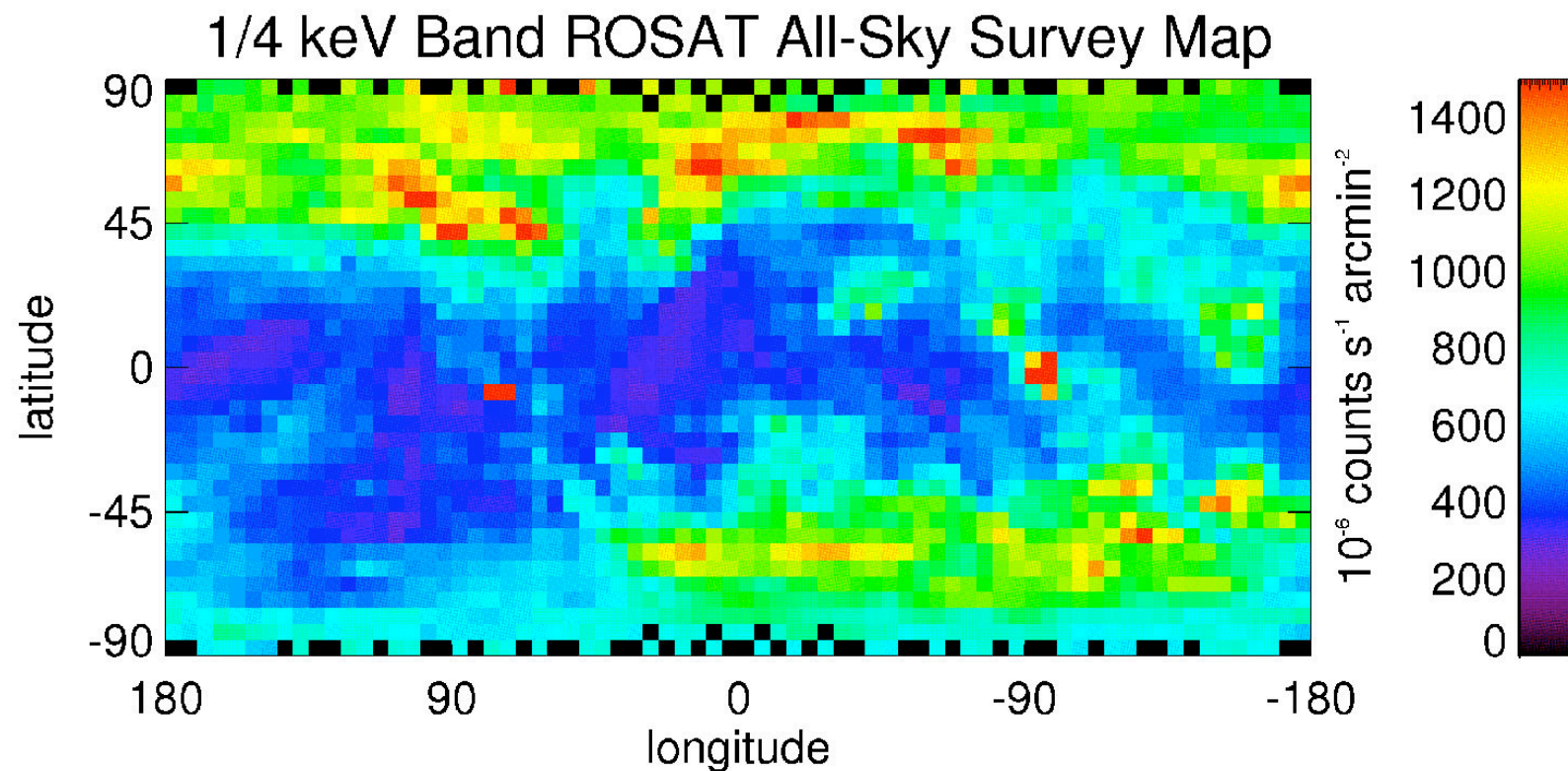
Total X-ray intensities galactic map



Total X-ray intensities constant sw flux

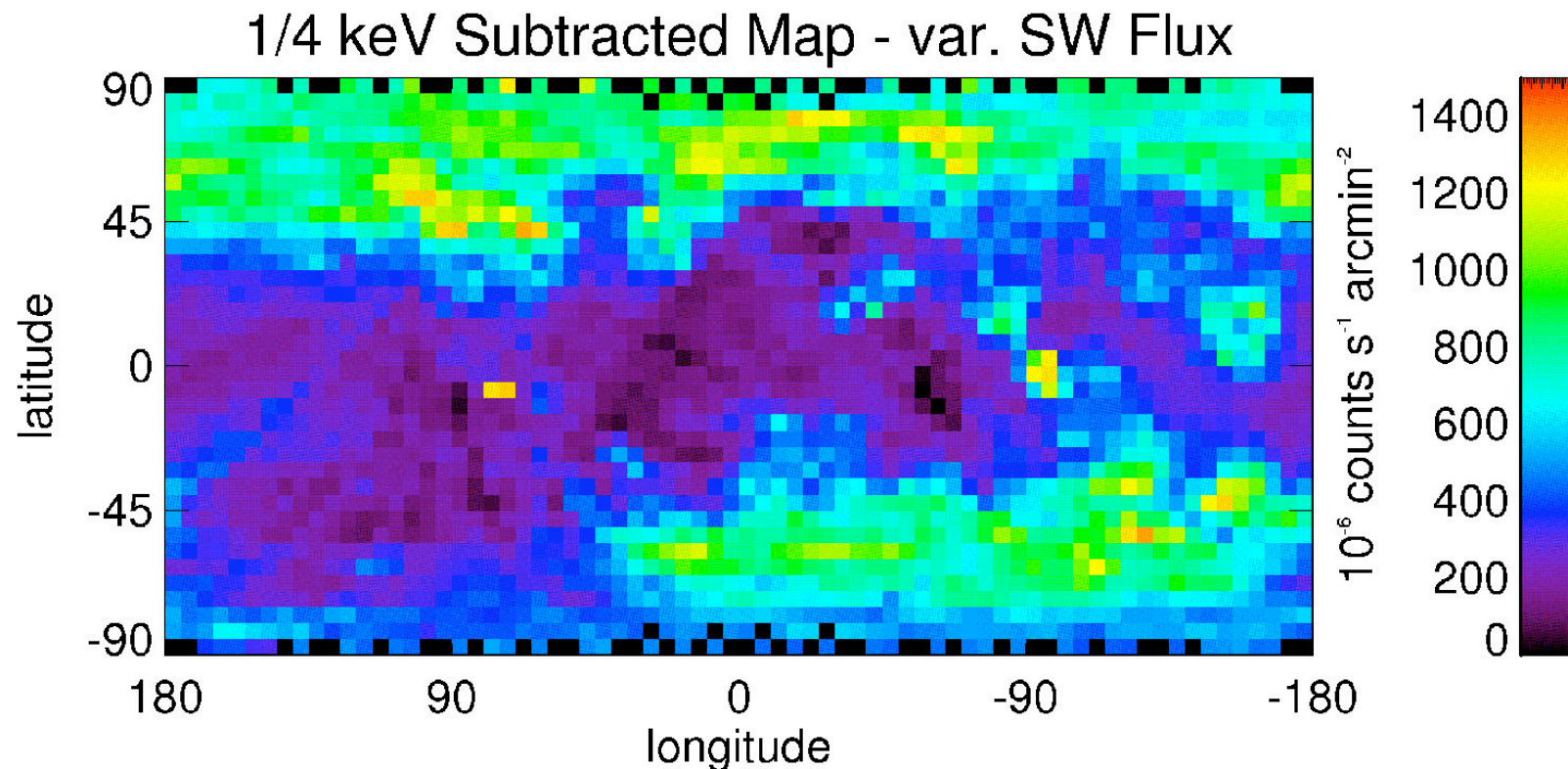


1/4 keV ROSAT sky-map

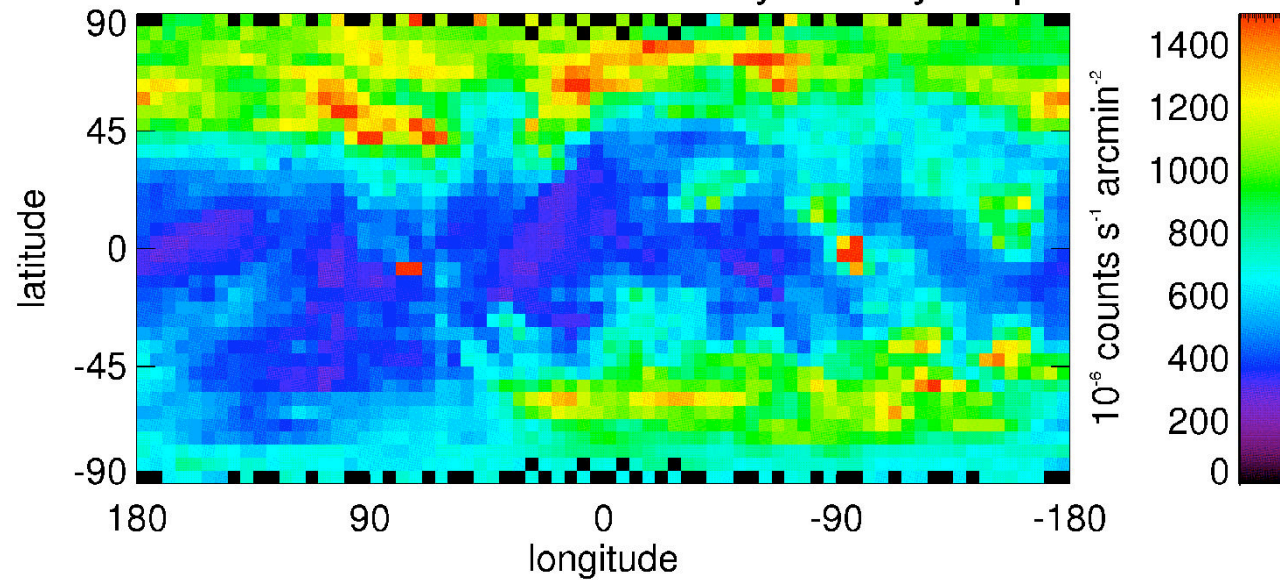


New sky-map

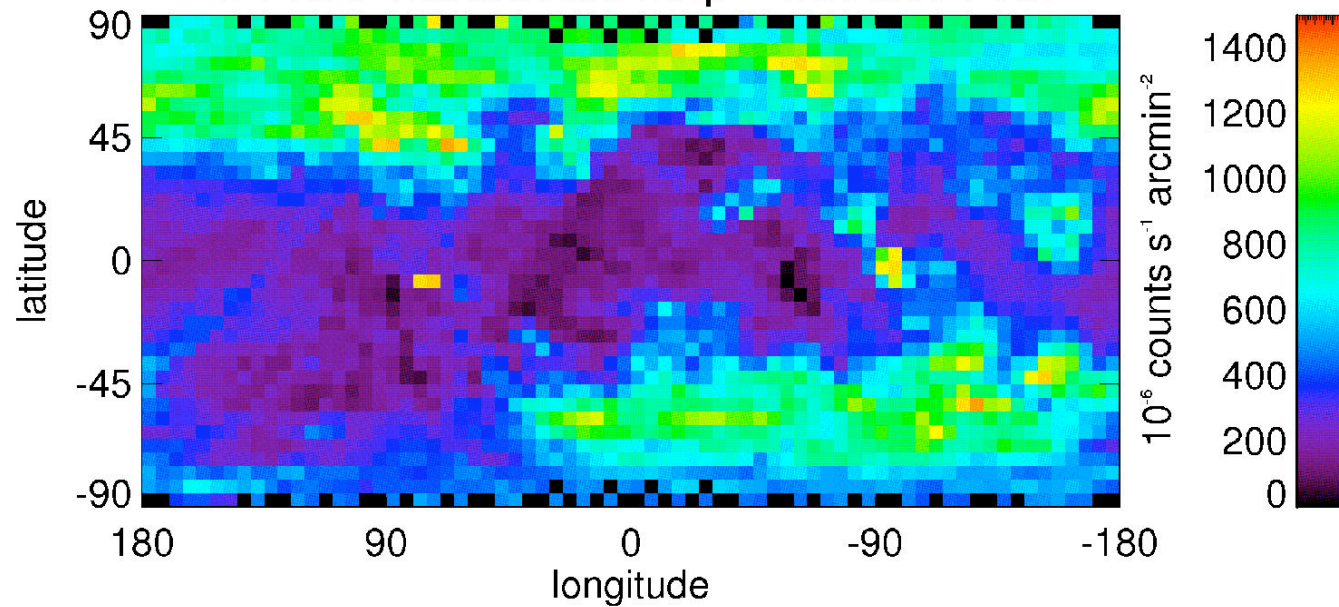
Background subtracted



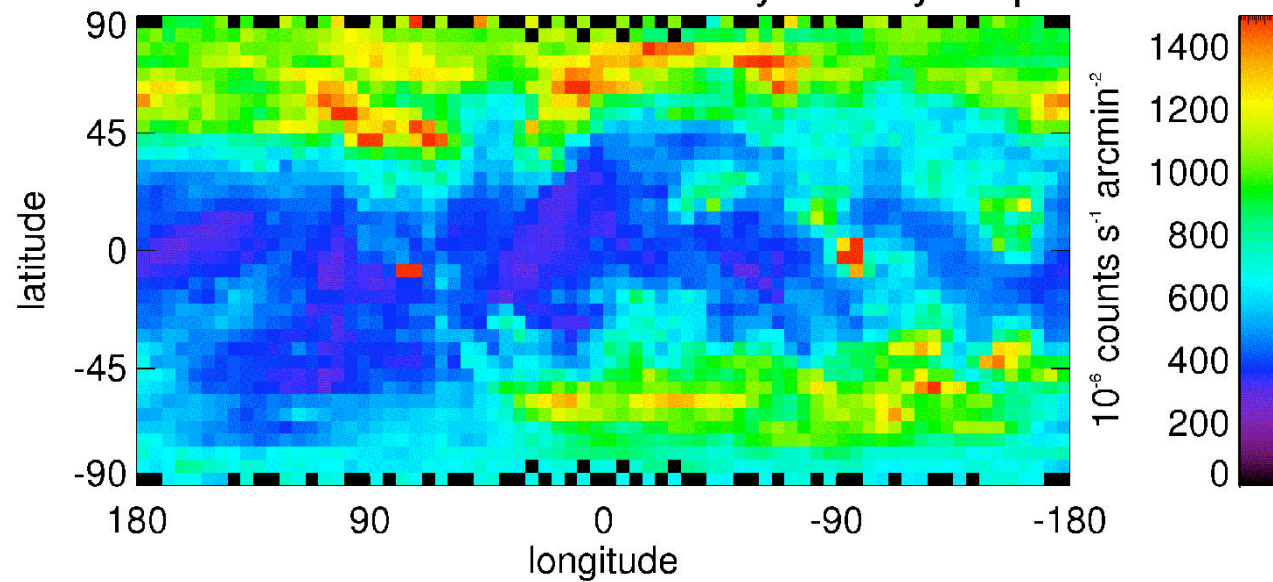
1/4 keV Band ROSAT All-Sky Survey Map



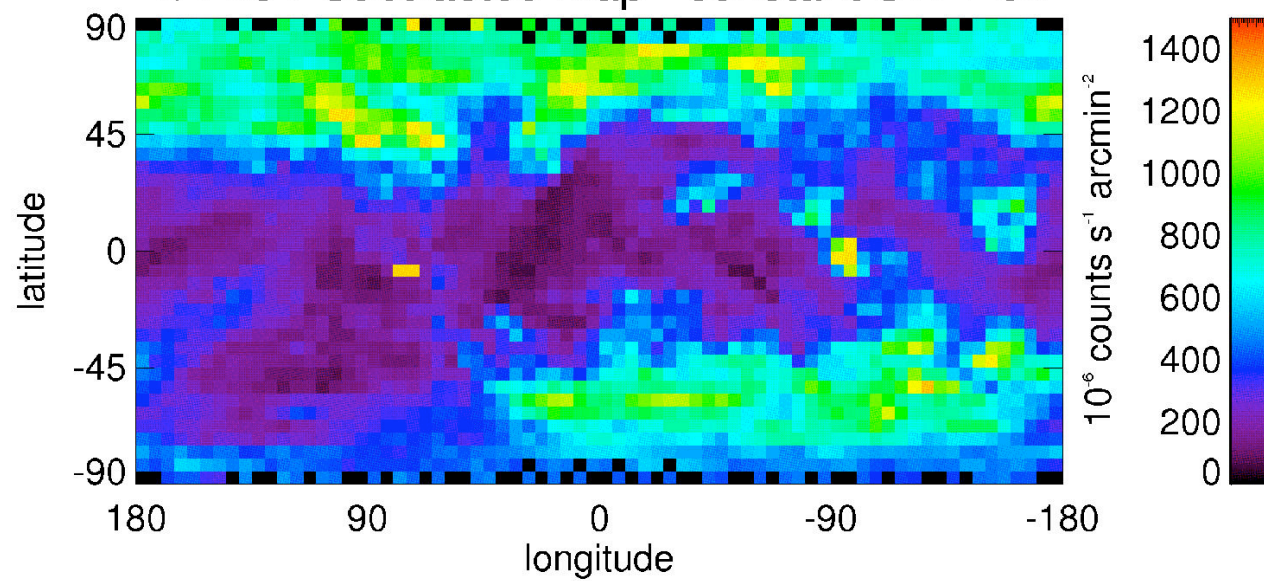
1/4 keV Subtracted Map - var. SW Flux



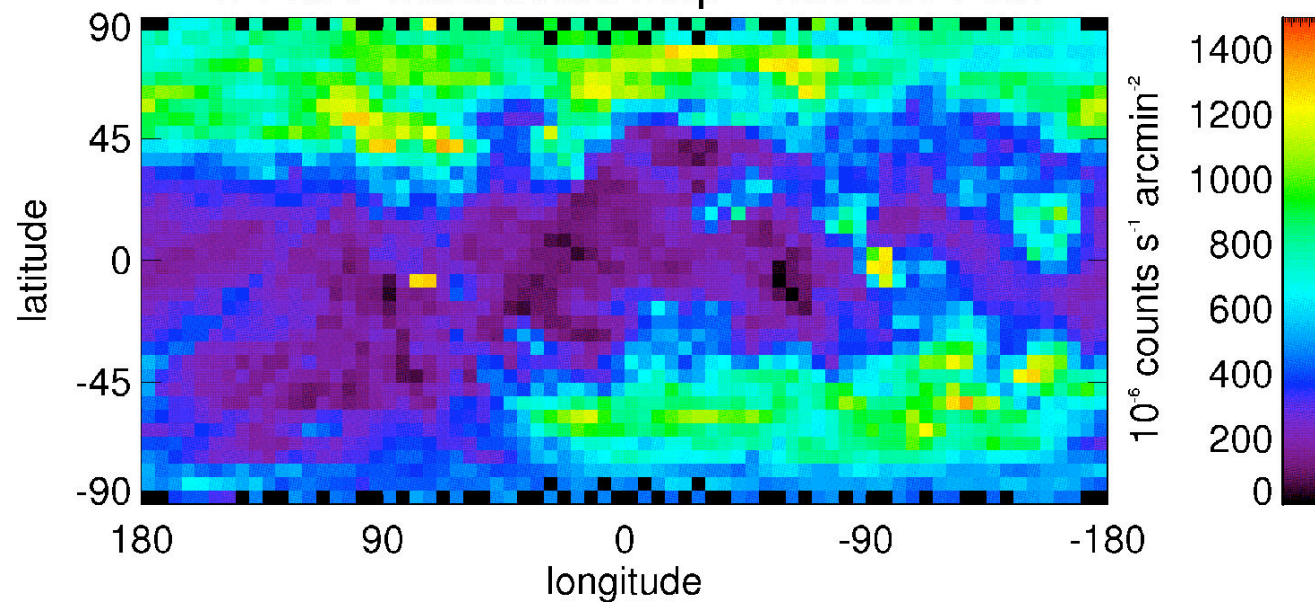
1/4 keV Band ROSAT All-Sky Survey Map



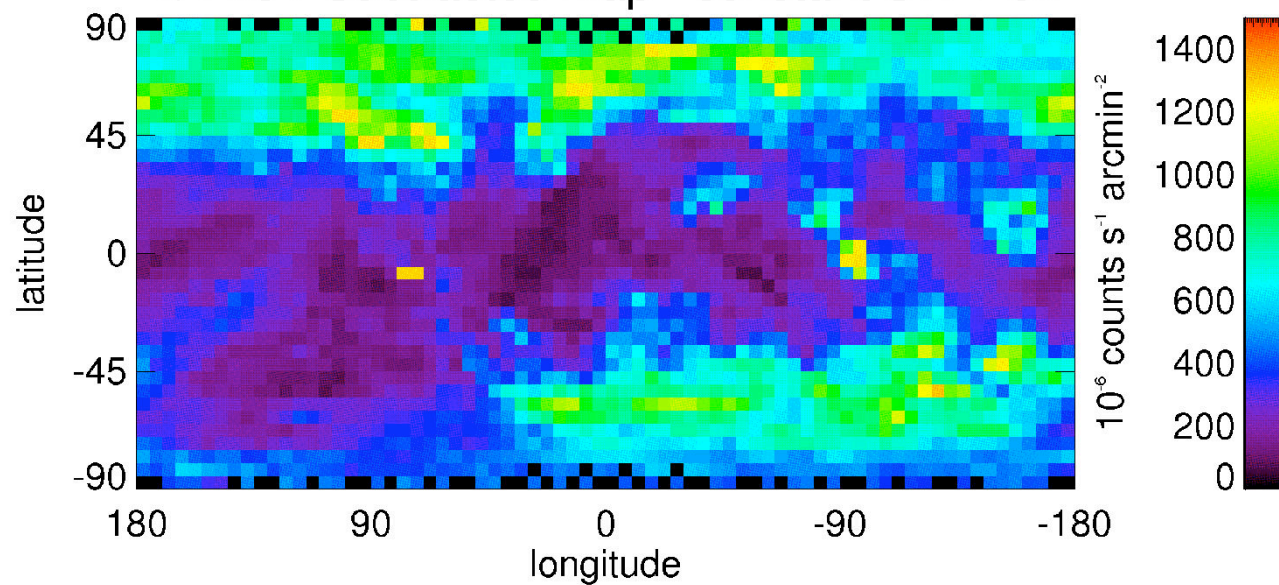
1/4 keV Subtracted Map - constant SW Flux



1/4 keV Subtracted Map - var. SW Flux

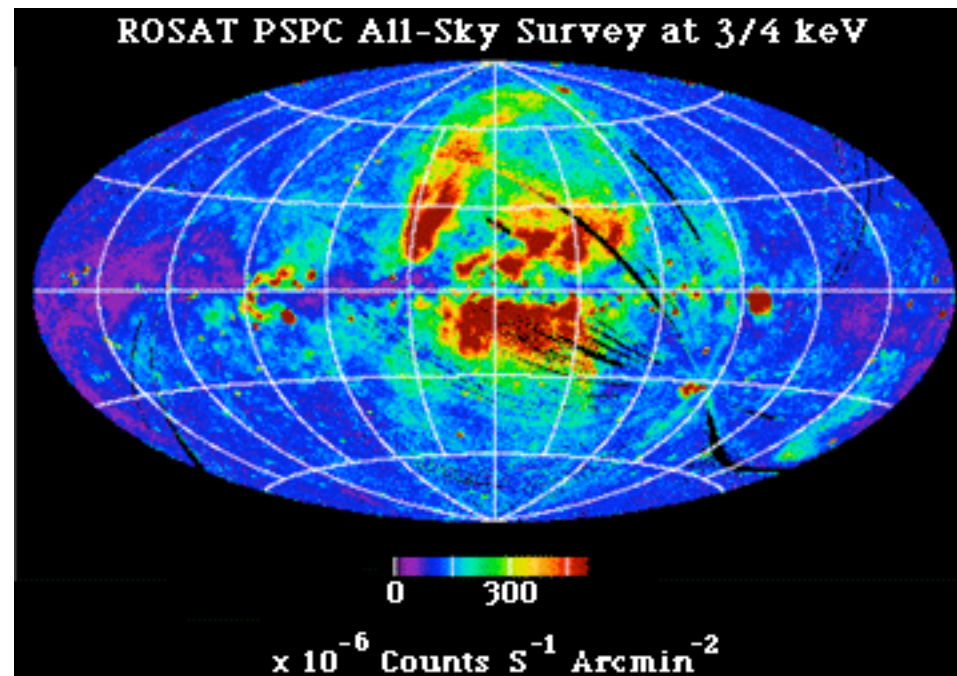
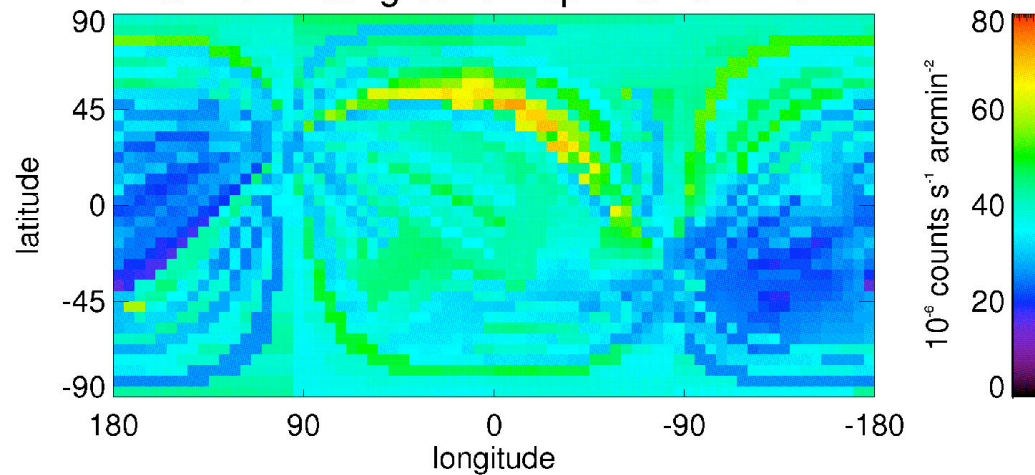


1/4 keV Subtracted Map - constant SW Flux



3/4 keV band

3/4 keV Background Map - var. SW Flux



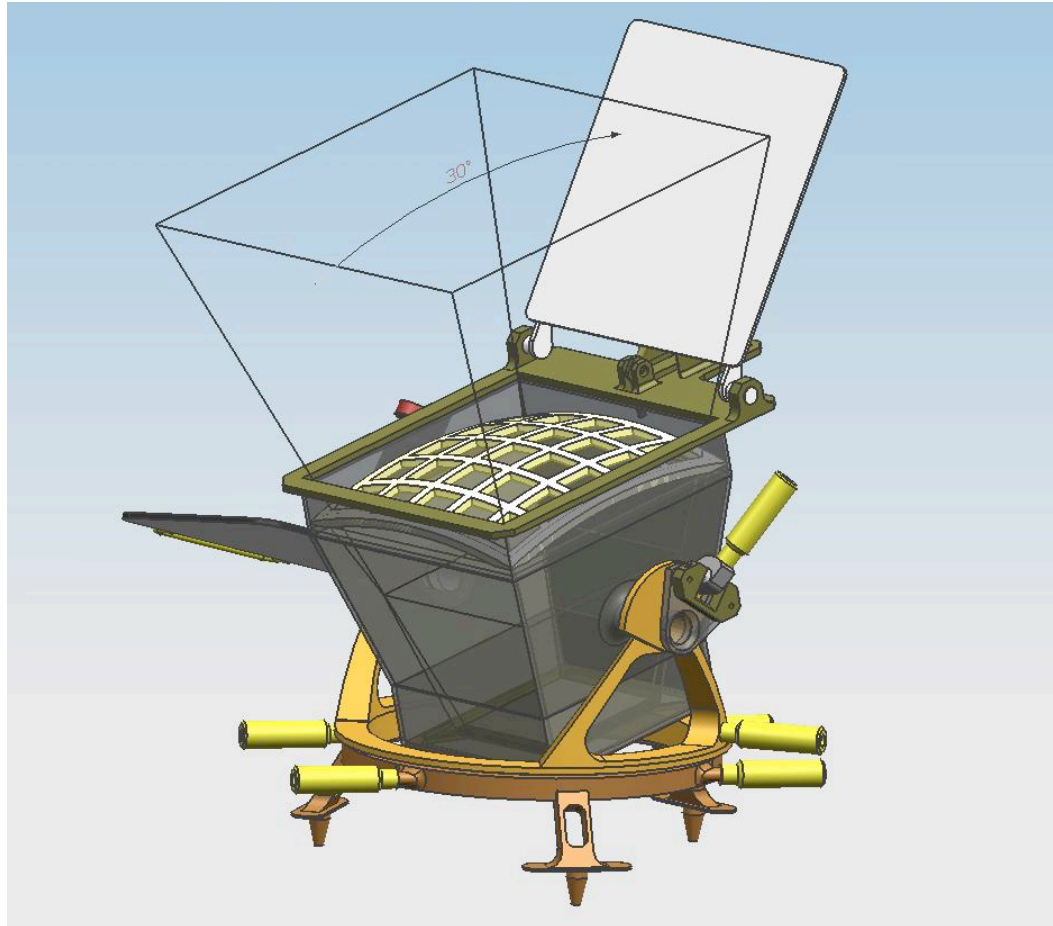
Conclusions part I

- In the lower galactic latitudes about 50% of both ROSAT sky-map is heliospheric in nature, while in the higher latitudes this percentage is about 25%.
- Results depend on accuracy of solar wind flux and neutral densities.

Observations from the Moon

1. Can observe SWCX X-ray emission from Earth
2. Pointing away from Earth, can observe X-ray emission from SWCX with interstellar neutrals.

MagEx



Movie

Final Conclusions

- We have attempted to model the heliospheric background component of the ROSAT soft X-ray map and estimate that roughly 50% of the equatorial region is heliospheric in nature.
- Estimates can be improved by observations from the Moon or other place outside the bow shock.